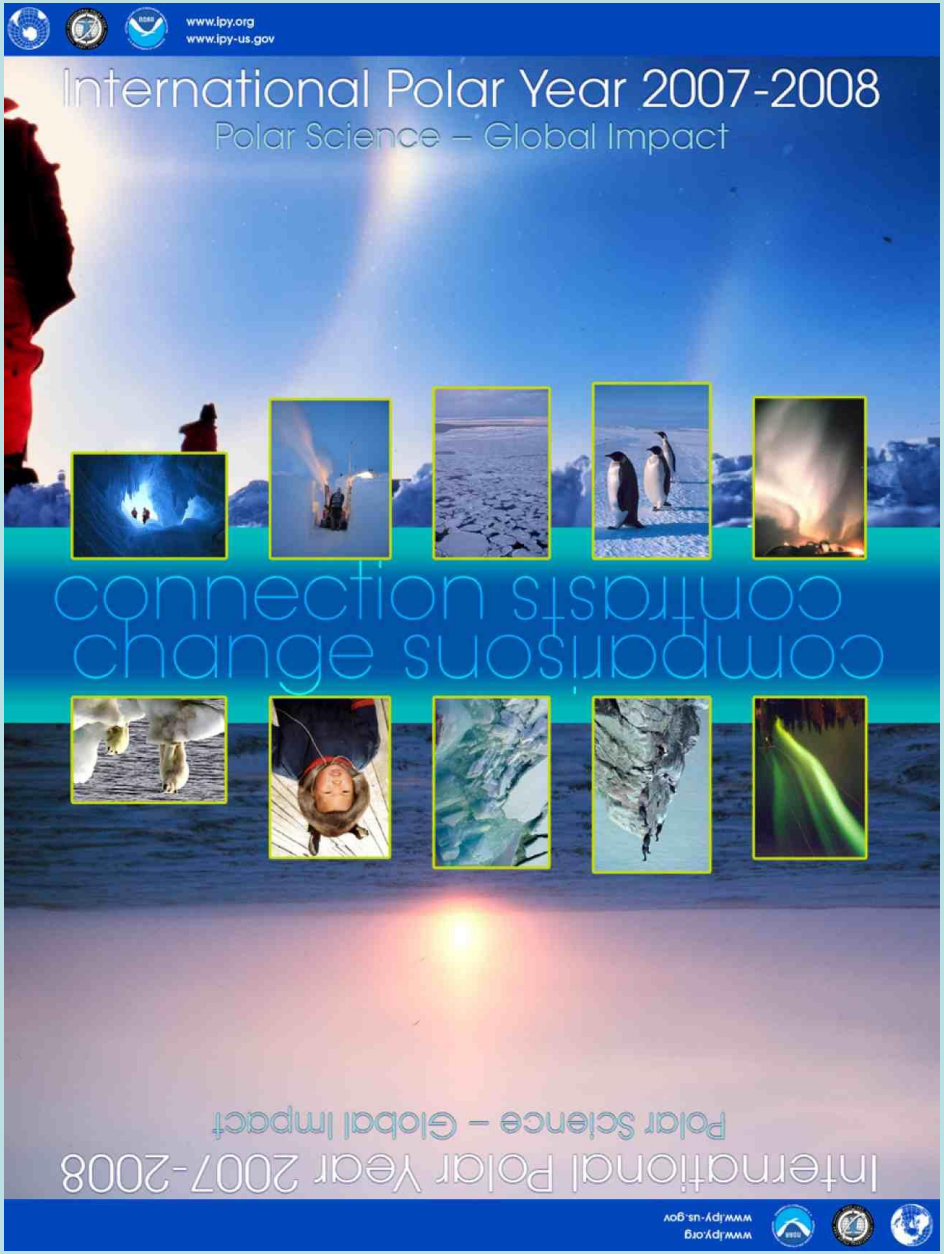


NOAA's Role in the Arctic

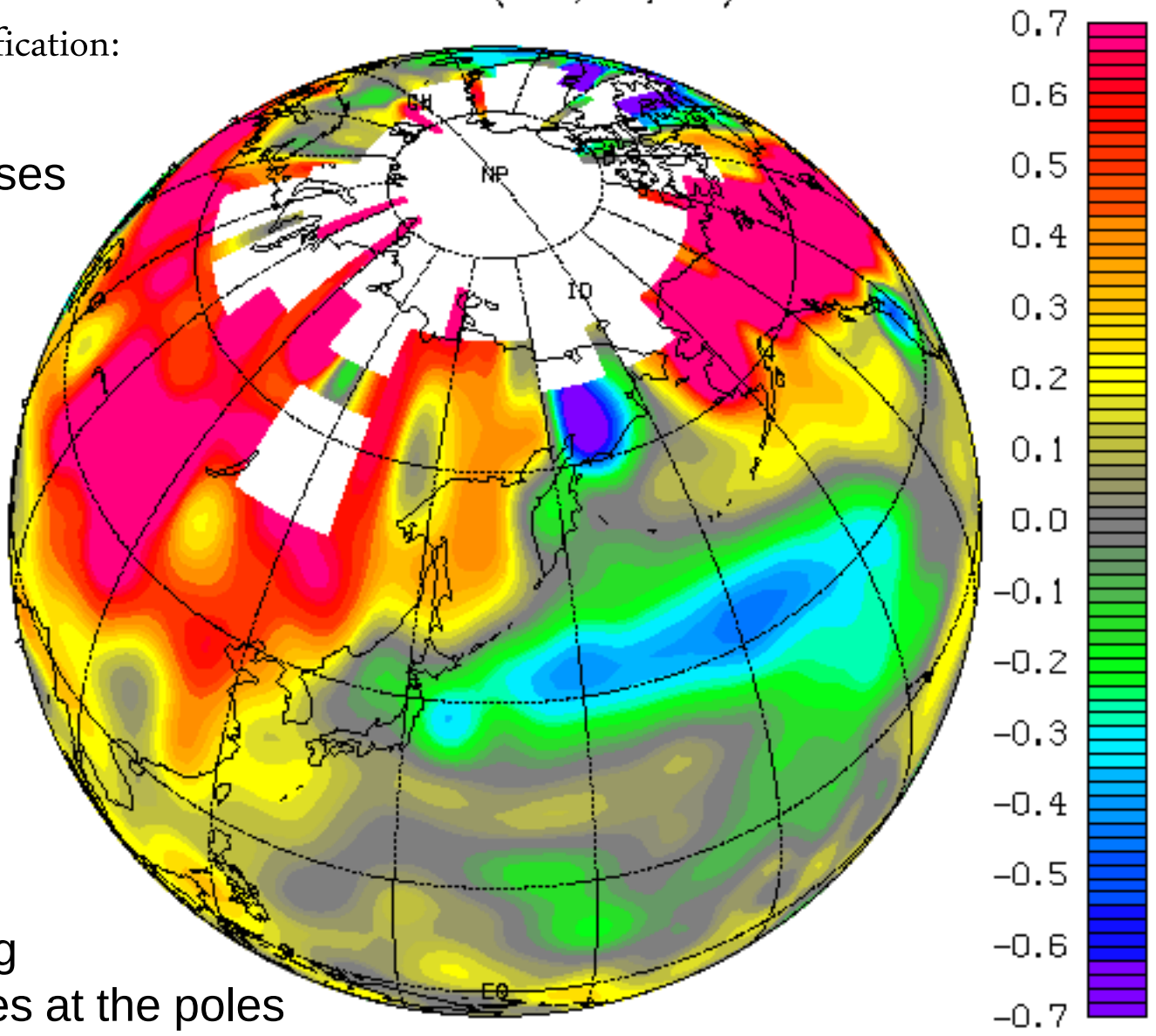
Presentation by Kathleen Crane
Arctic Research, Climate Program Office
National Oceanic and Atmospheric Administration
kathy.crane@noaa.gov

NOAA's Role in the Arctic:

Ocean Observations
Atmospheric Observatories
Exploration
Ecosystems and Climate
Transportation
Stewardship

Arctic Amplification:

What Causes Arctic Sea ice melt?



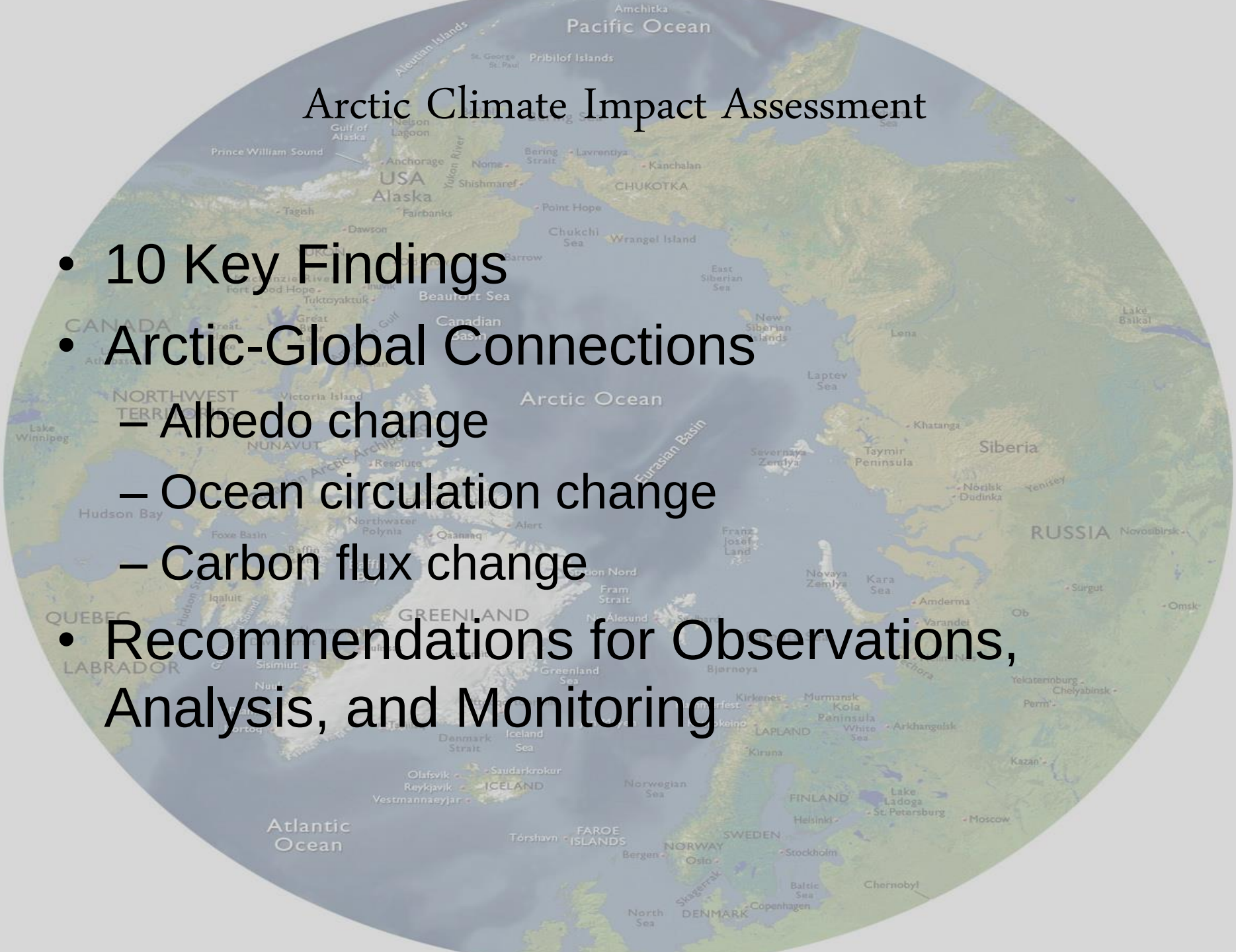
1) Increasing Temperatures at the poles

Observed Changes in the Arctic:

- Increases in precipitation
- Winter temperatures increasing
- Thawing of previously frozen ground
- Variations in the ranges of ecosystems
- Increases in storm surges and coastal erosion
- Reduced sea ice thickness and extent
- Warming of the Arctic Ocean waters

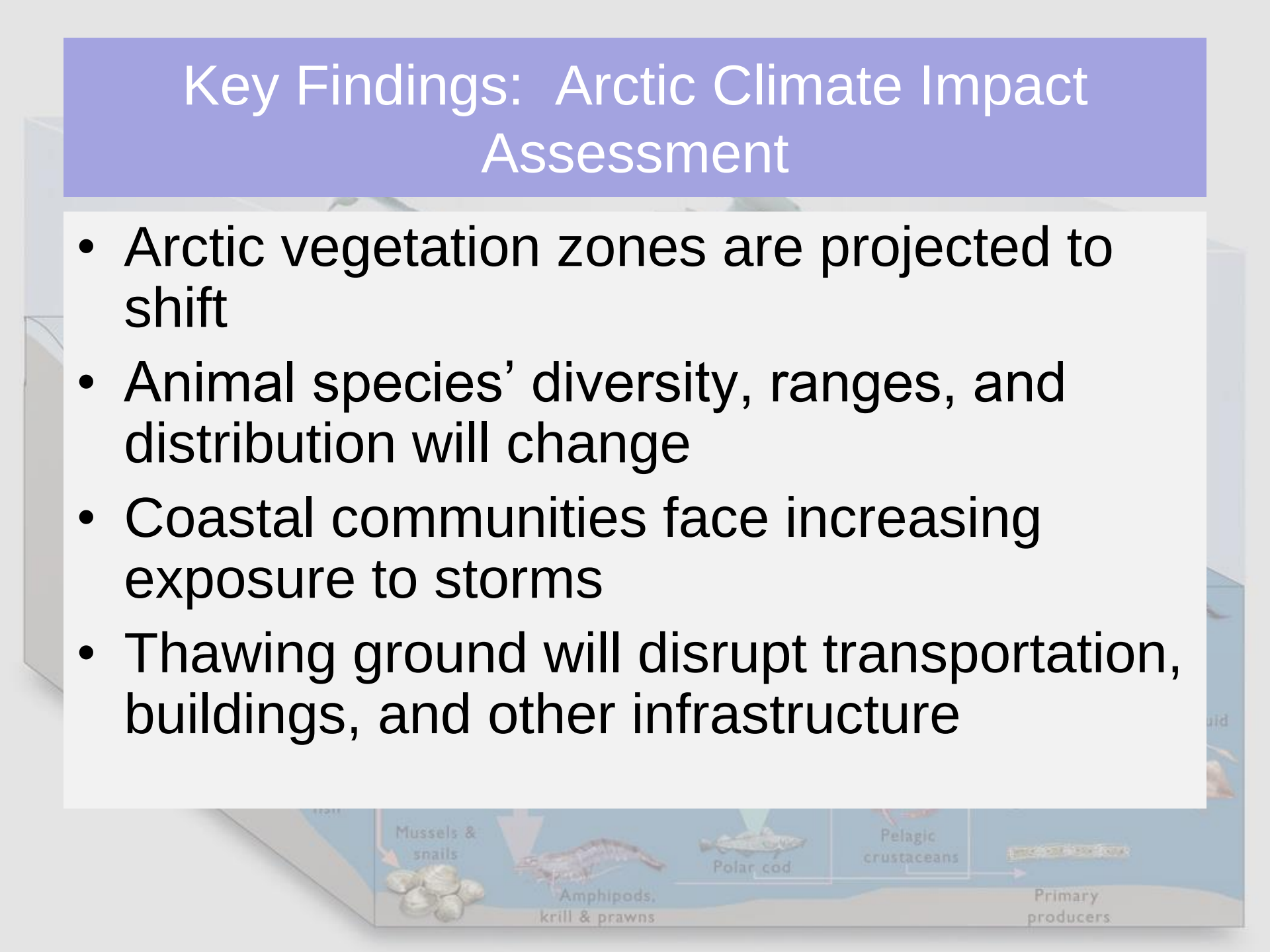
Arctic Climate Impact Assessment

- 10 Key Findings
- Arctic-Global Connections
  - Albedo change
  - Ocean circulation change
  - Carbon flux change
- Recommendations for Observations, Analysis, and Monitoring



Key Findings: Arctic Climate Impact Assessment

- Arctic vegetation zones are projected to shift
- Animal species' diversity, ranges, and distribution will change
- Coastal communities face increasing exposure to storms
- Thawing ground will disrupt transportation, buildings, and other infrastructure



Changes in sea ice cover

Change in planetary albedo

Melting permafrost

release of greenhouse

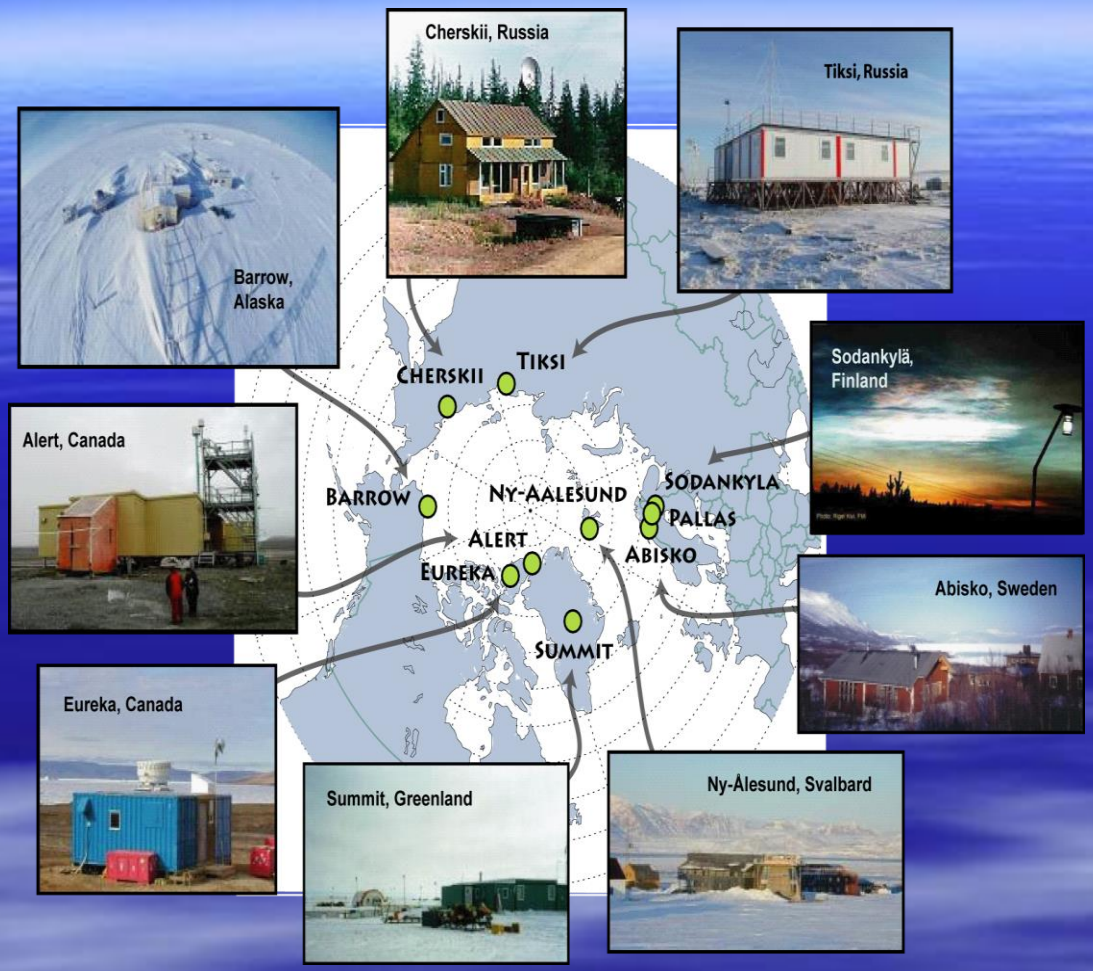
sequestered gases

Melting Greenland ice sheet – Rises in sea level

Atmospheric influences on the total system are profound

Unique Value - International

Arctic Climate Observatories, IASOA

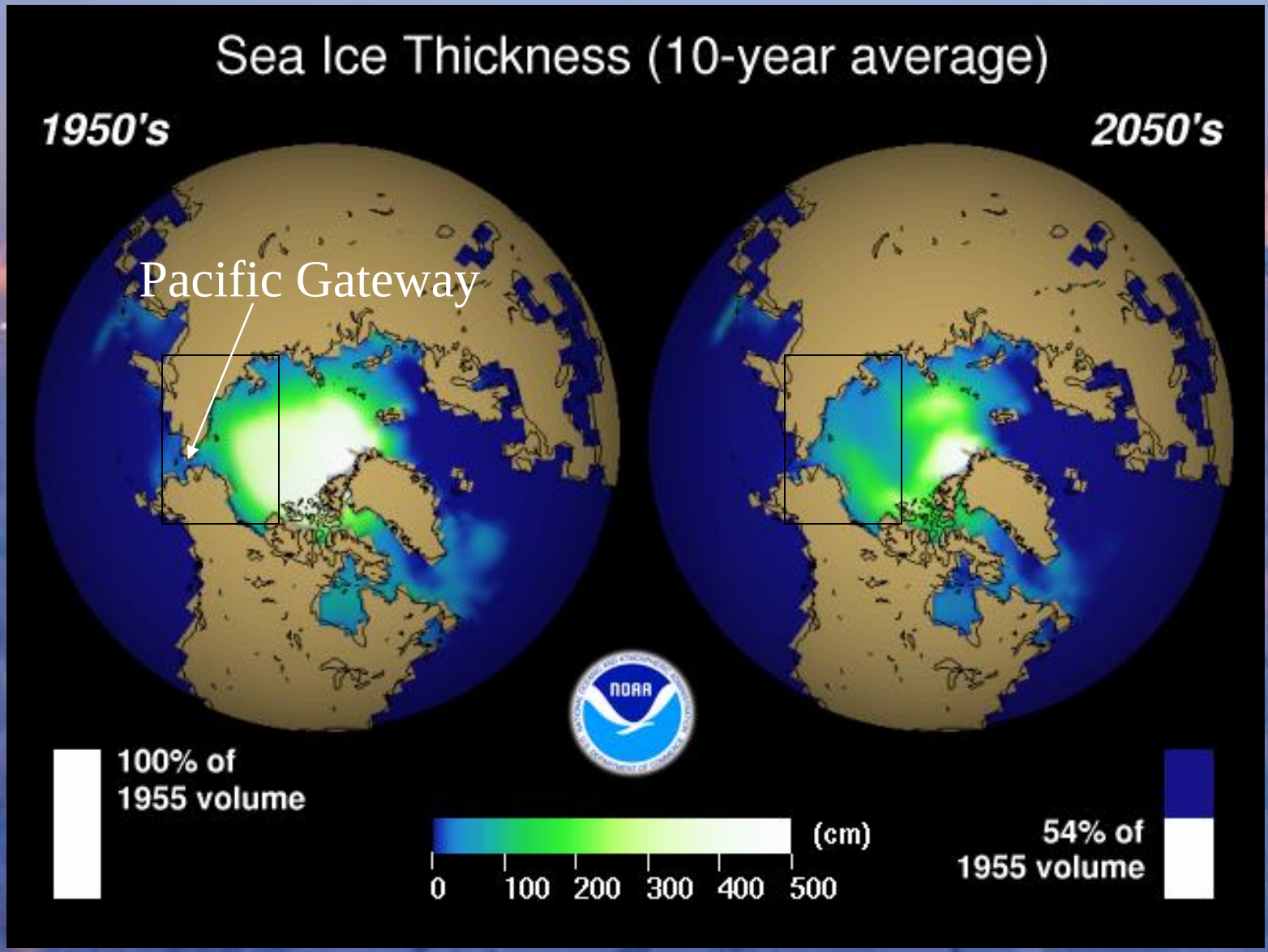


- How does Arctic atmosphere interact with the rest of the Arctic (marine, ice and terrestrial) system?
- Which recent changes in the Arctic climate contribute to severe weather events in the middle latitudes?
- In 2014 6 of the Arctic Observatories recorded carbon dioxide concentrations of > 400 ppm

NOAA instrumentation is onsite to provide continuous ozone, black carbon, carbon cycle gas, and greenhouse gas sampling. Flasks are collected weekly for carbon cycle gasses and halocarbon flasks are collected bi-weekly.

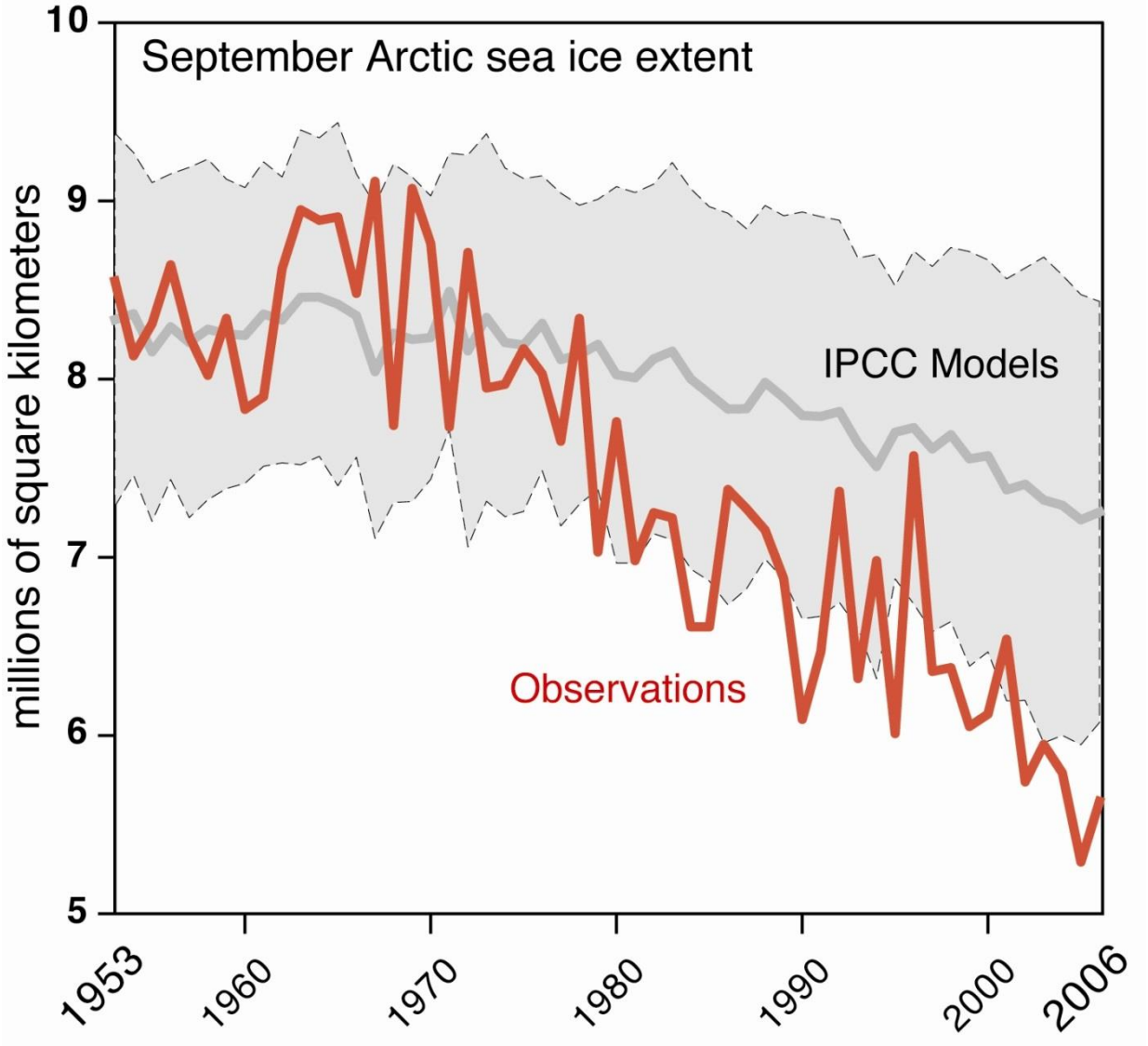
Co funding from Canada, Russia, Finland, Norway, Sweden, Denmark, NSF, NOAA

T. Uttal Lead for NOAA



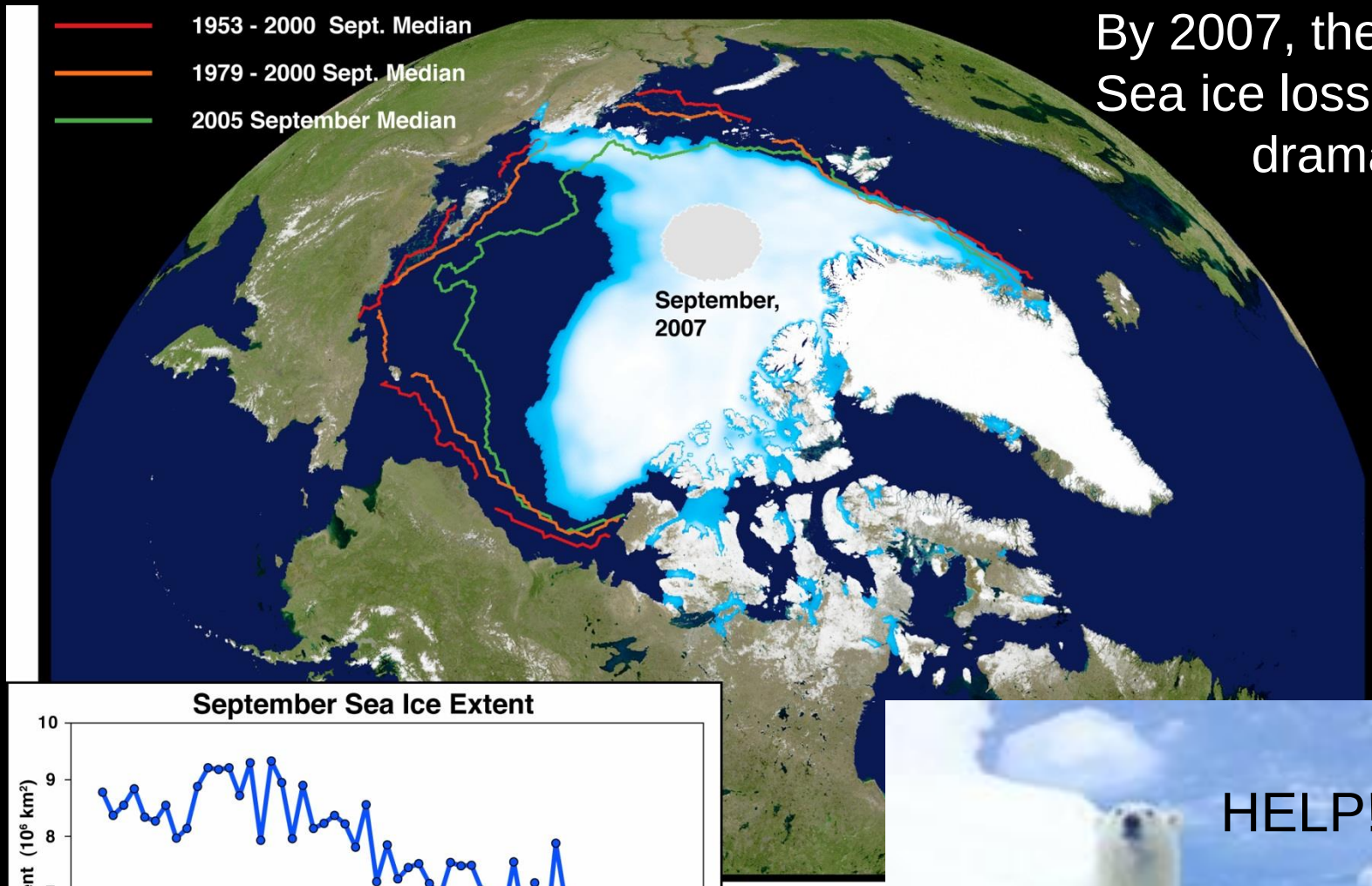
In 2000, sea ice models predicted a substantial loss by 2050

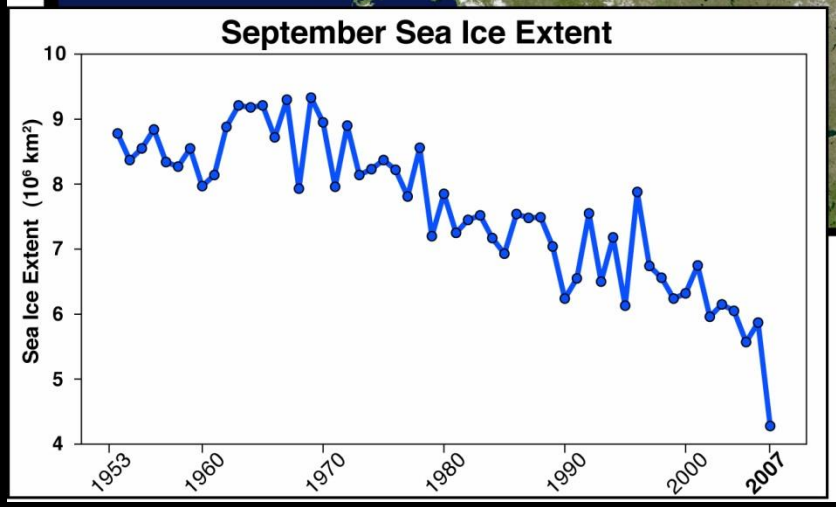
Sea Ice Decreasing Faster than Predictions

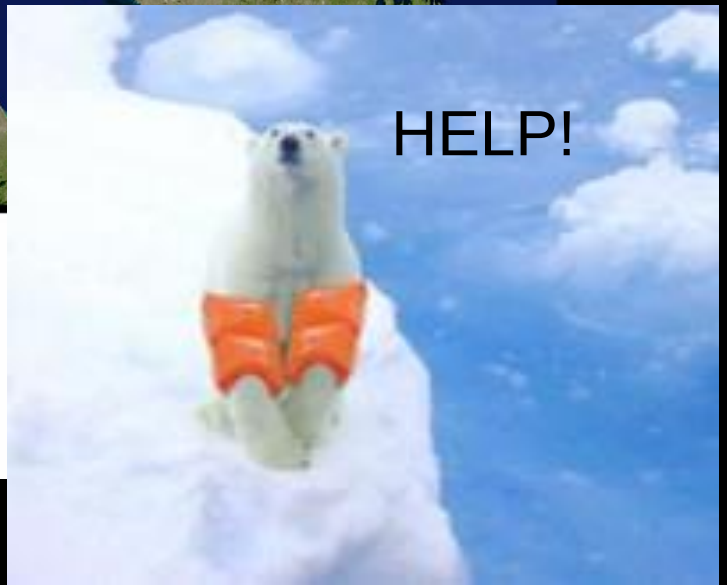


From Mark Serreze - U. Colo./CIRES

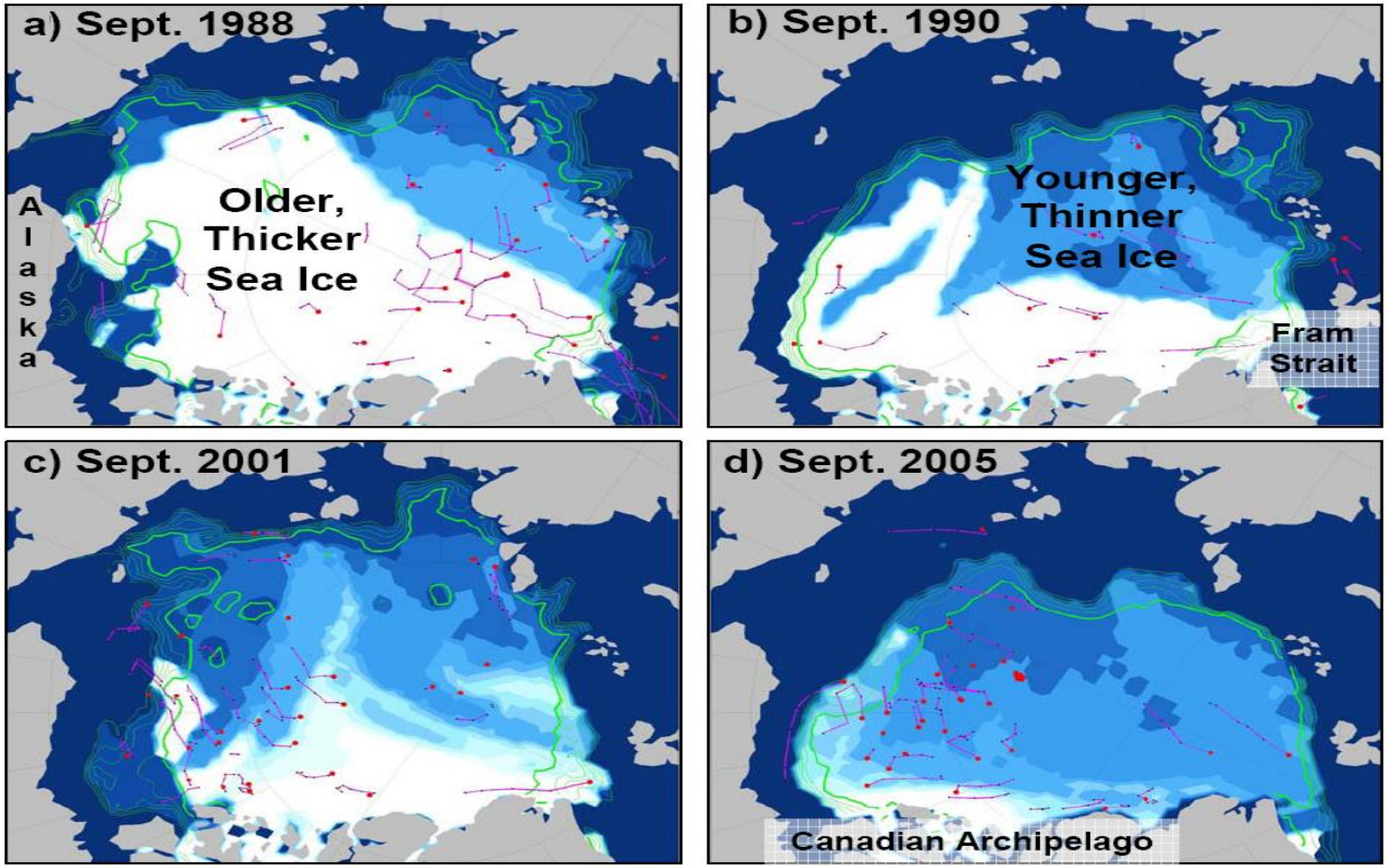
By 2007, the rate of Sea ice loss increased dramatically





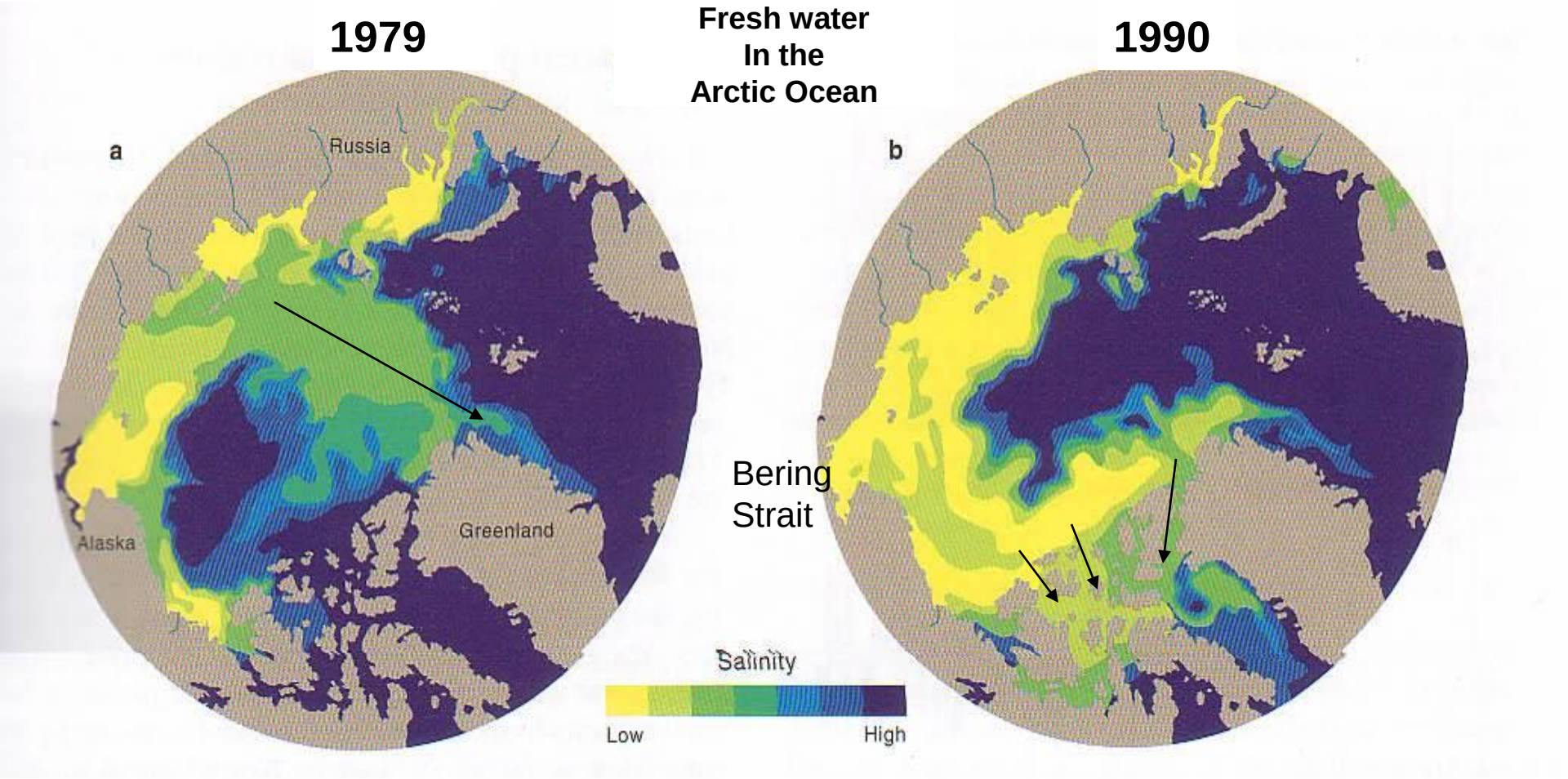


There were also large changes in the age of sea ice 1988-2005 (NOAA 2006)

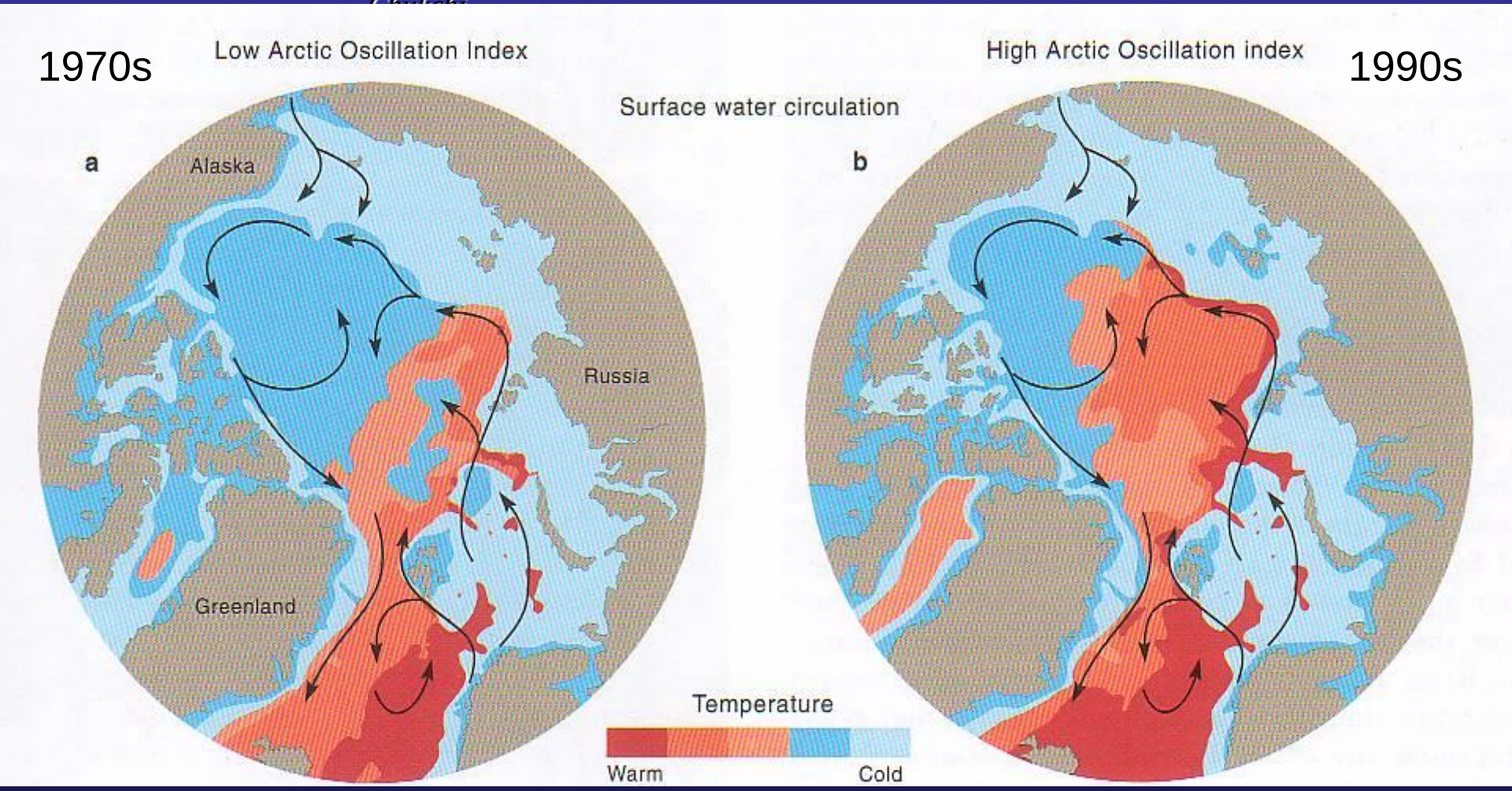


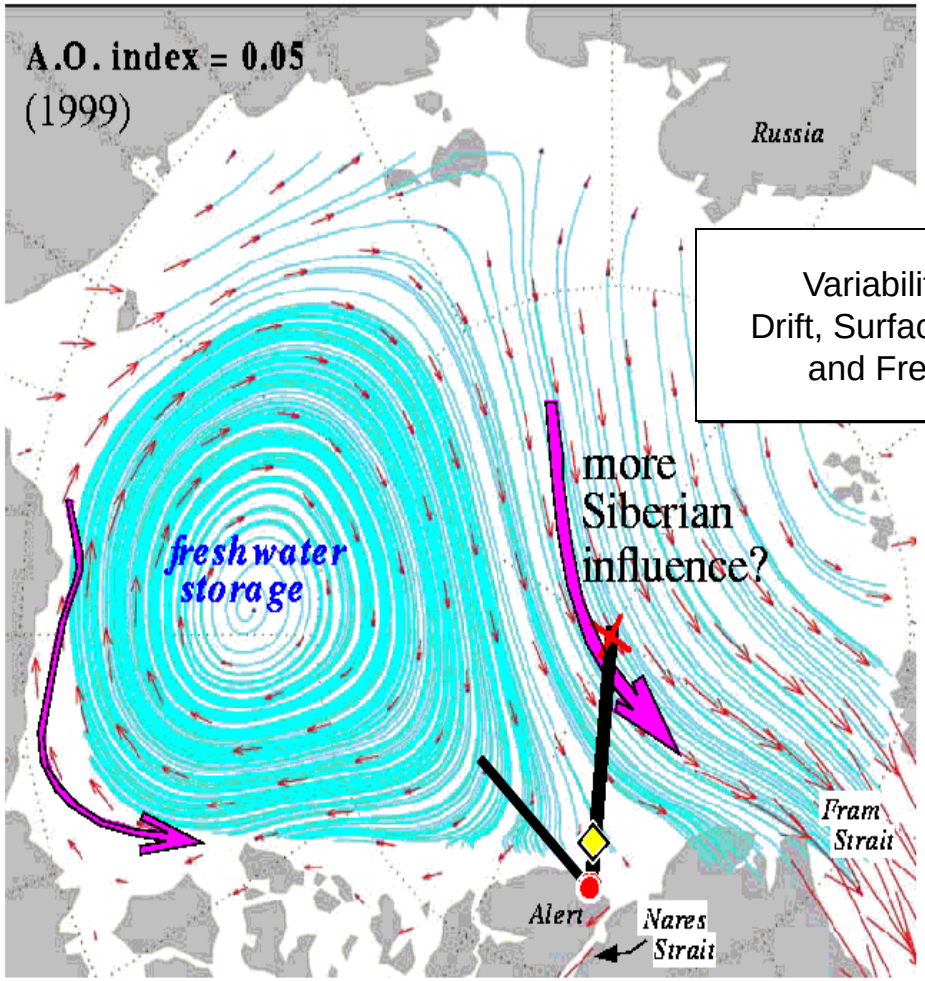
From Pal Prestrud - CICERO

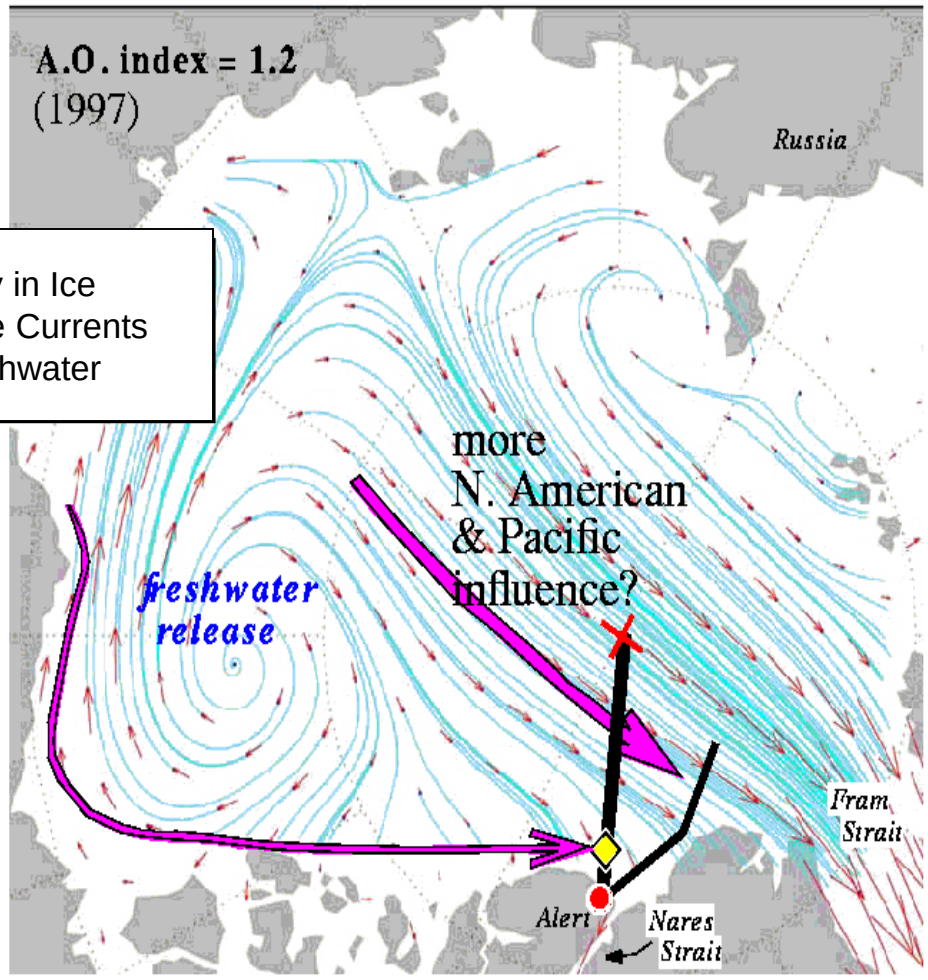
The sources and pathways of fresh water into and out of the Arctic Ocean have changed:



Incursion of Warm Atlantic Water into the Arctic signaled the importance of heat transported via the Atlantic Ocean into the Arctic







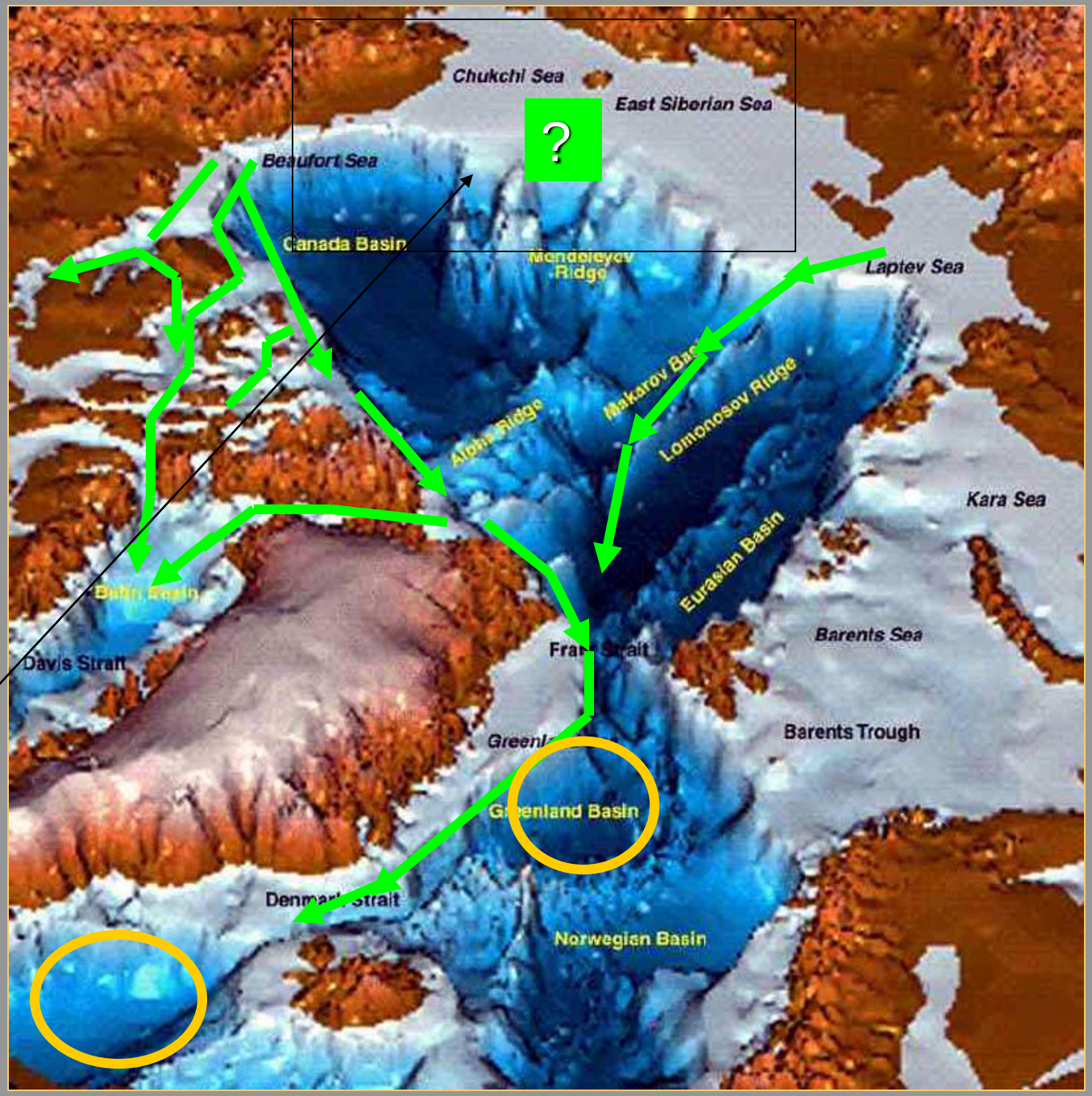
Variability in Ice Drift, Surface Currents and Freshwater

Changing shape of the Beaufort Gyre, Surface Transport Pathways in Response to the Arctic Oscillation.

M. Steele, P. Schlosser, B. Smethie, and R. Kwok, 2004, Circulation in the “Freshwater Switchyard” of the Arctic Ocean
…based on *Jones et al.* (1998); *Steele & Boyd* (1998); *Proshutinsky et al.* (2002); *Rigor et al.* (2002)

Increased Fresh Water Flow From the Arctic to the North Atlantic

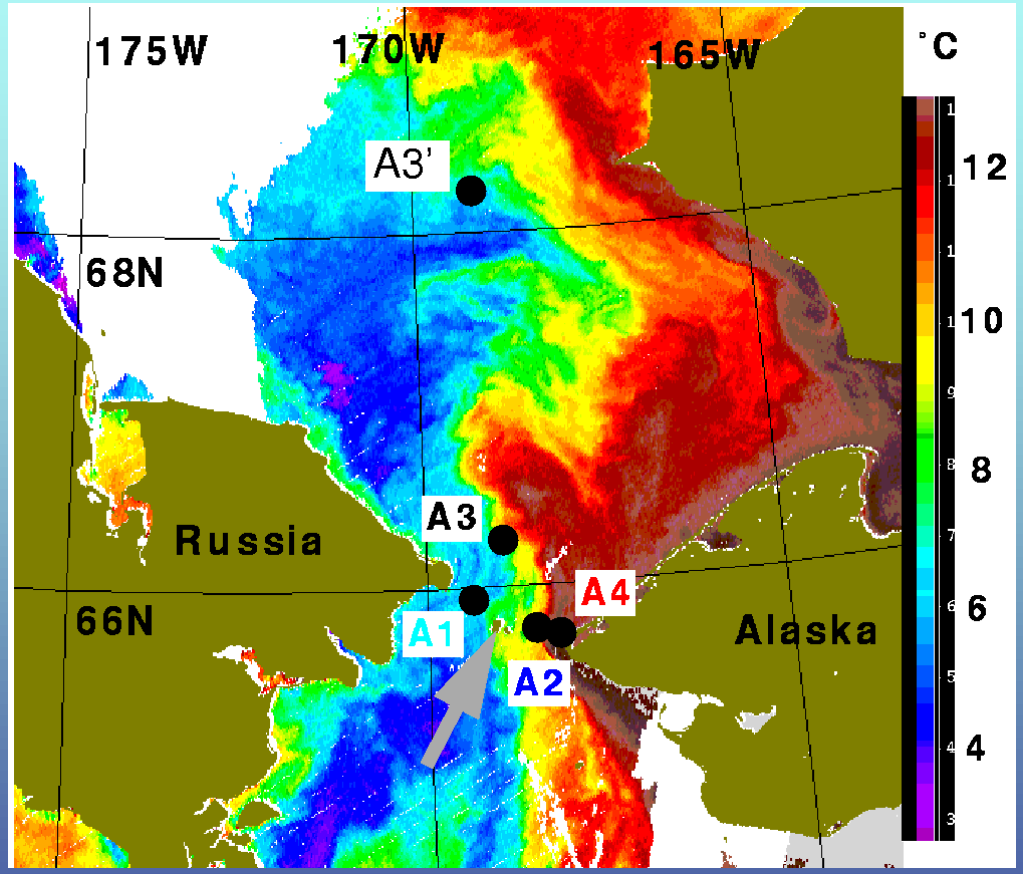
What are the pathways of fresh water flow across the Pacific Gateway ?



International Monitoring of Gateways to and from the Arctic

©2004, ACIA

A RUSALCA Goal: Gateway Flux Measurements via Long-term Moorings in Bering Strait

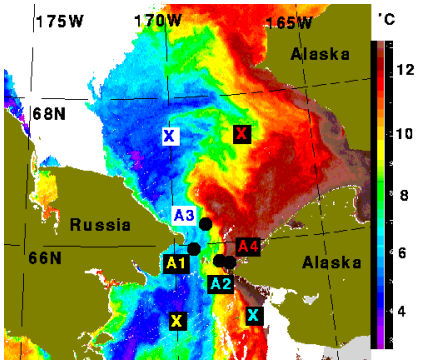


In 2008, RUSALCA installed 8 moorings from the USA to Russia.

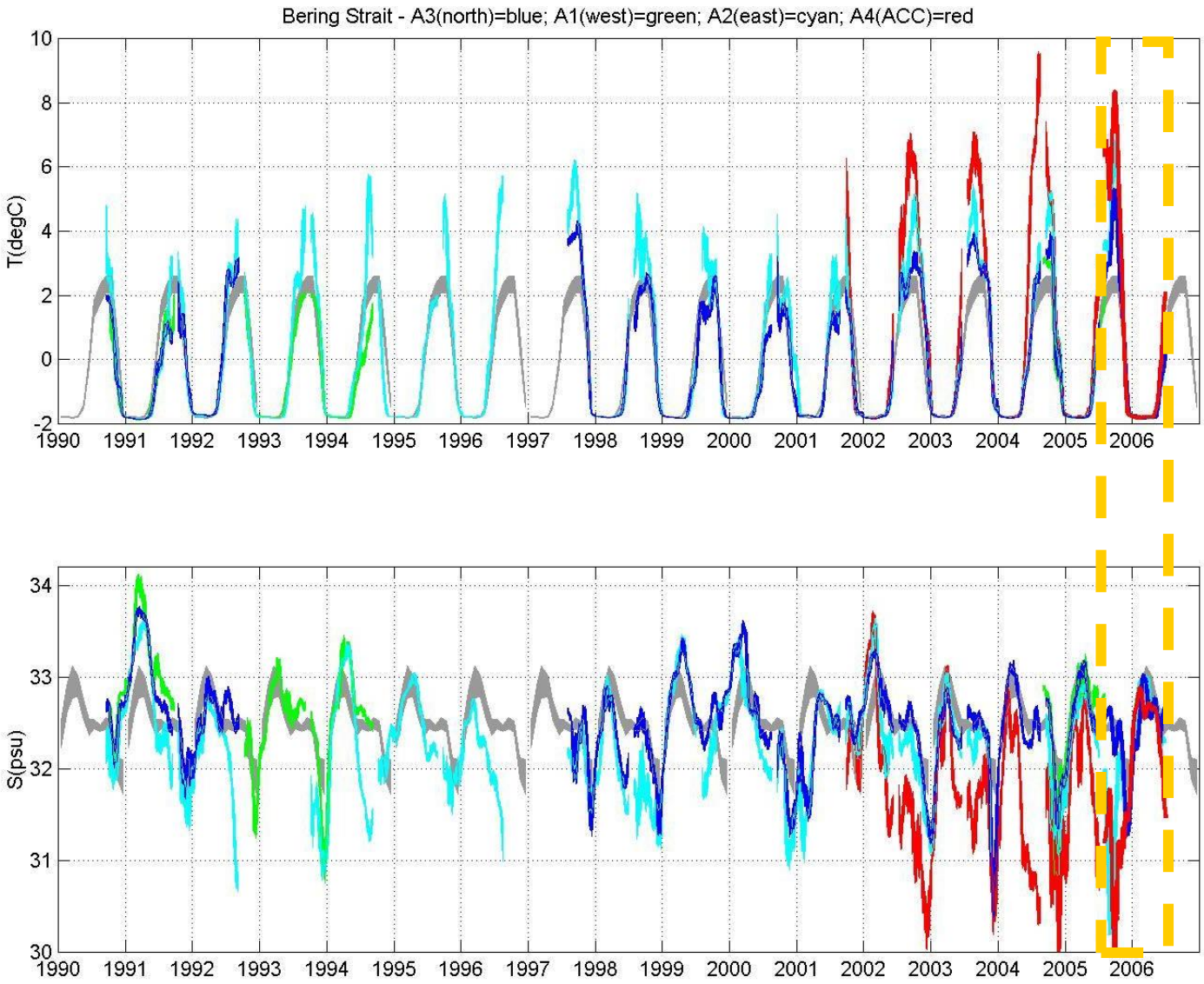
Sea Surface Temperature 26th August 2004, from MODIS/Aqua level 1

courtesy of Ocean Color Data Processing Archive, NASA/Goddard Space Flight Center, thanks to Mike Schmidt

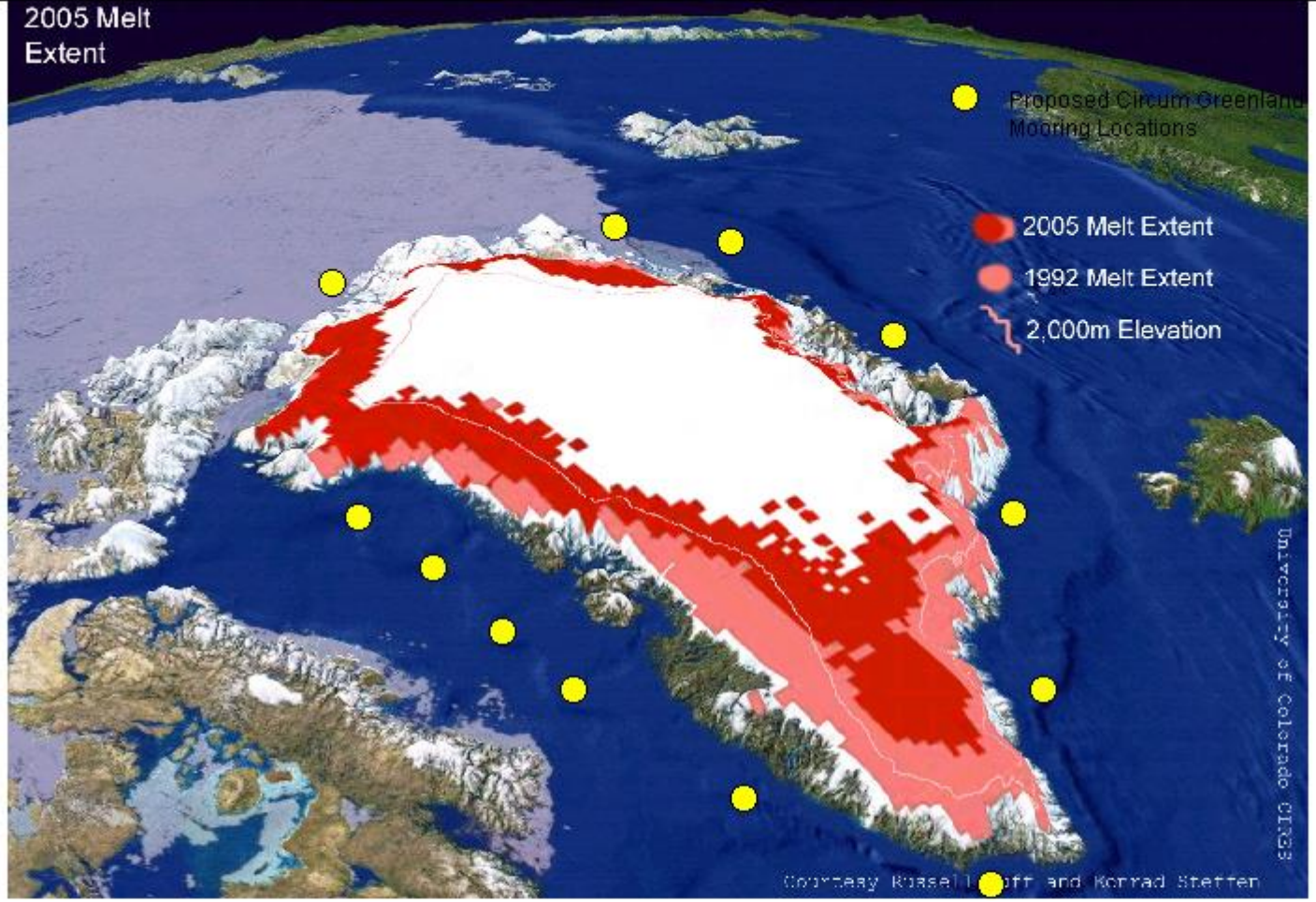
Grey arrow marks the Diomede Islands (Little and Big Diomede). Russian EEZ line passes between the islands.



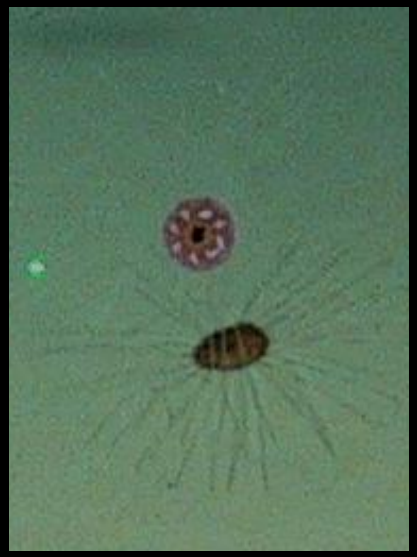
Bering Strait properties from 1990 to present



Incursion of warming water from the Pacific Ocean to the Arctic Ocean via the Bering Strait

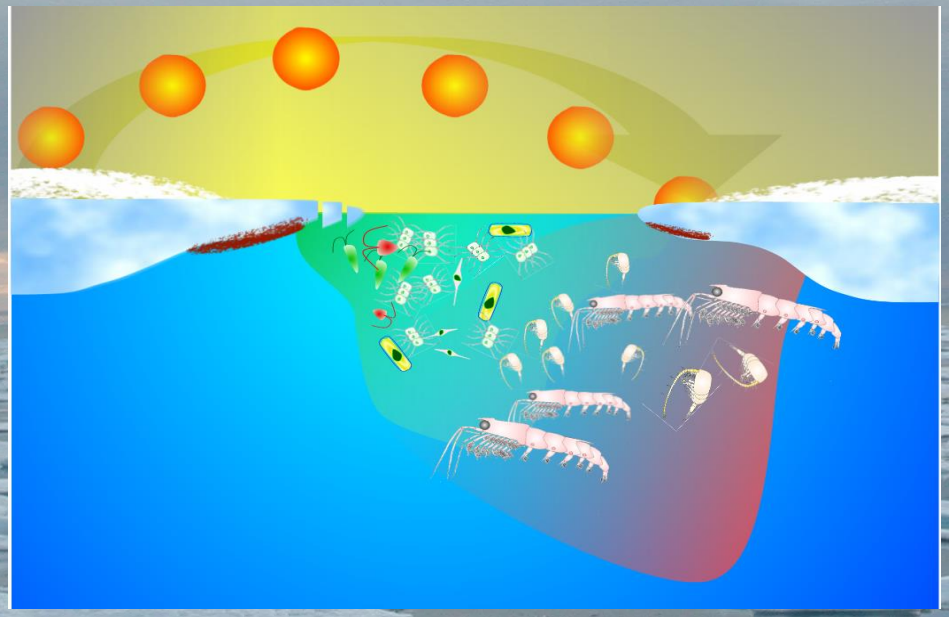


GREENLAND ICE CAP MELTING AND PROPOSED MOORING OBSERVING SYSTEM

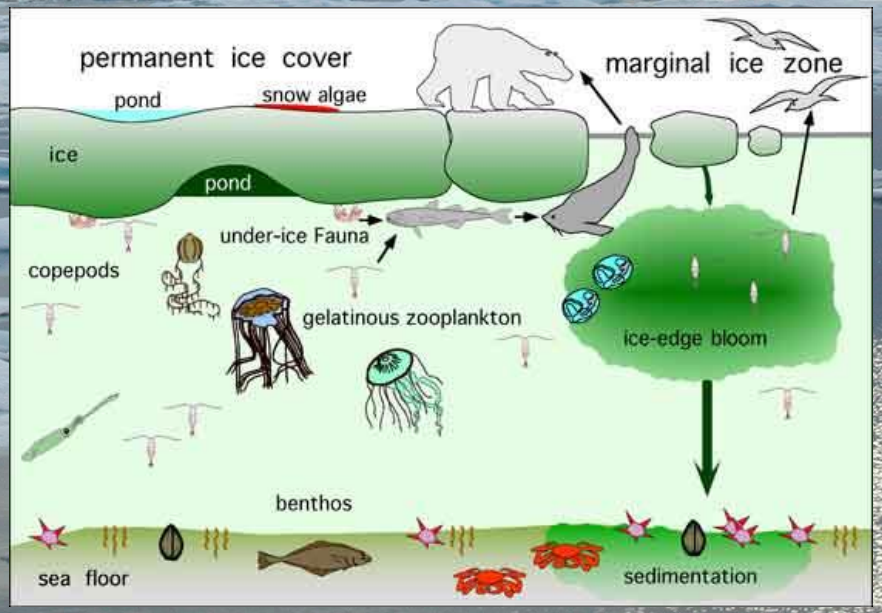


Arctic Climate Change will Alter ecosystems

Timing and location of ice algae growth depends on ice cover and light; zooplankton growth influences food reaching underlying sediments

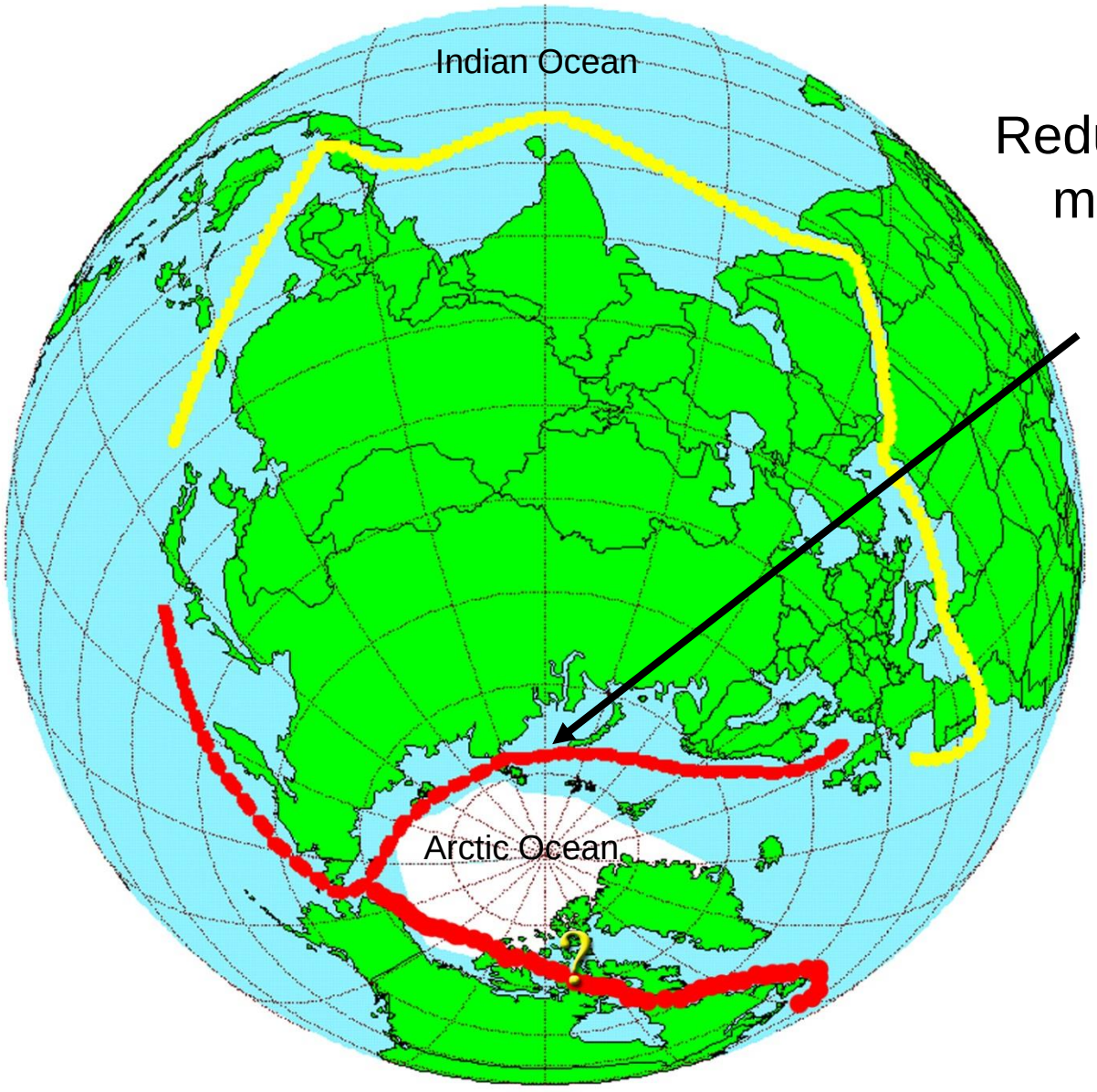


Wassman et al. 2004



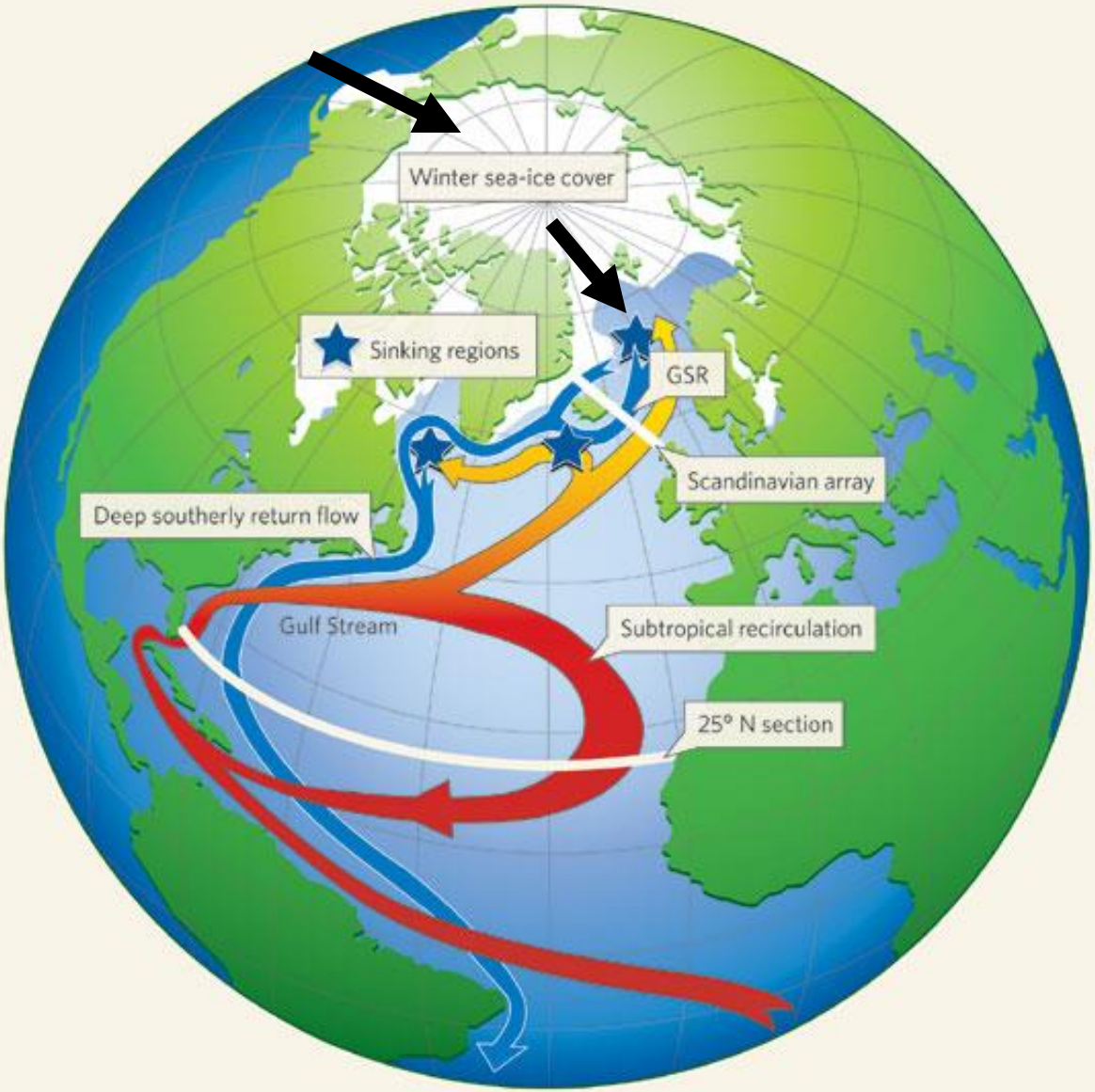
[Rolf Grandinger 2004]

Arctic Climate Change Impacts on Global Commerce

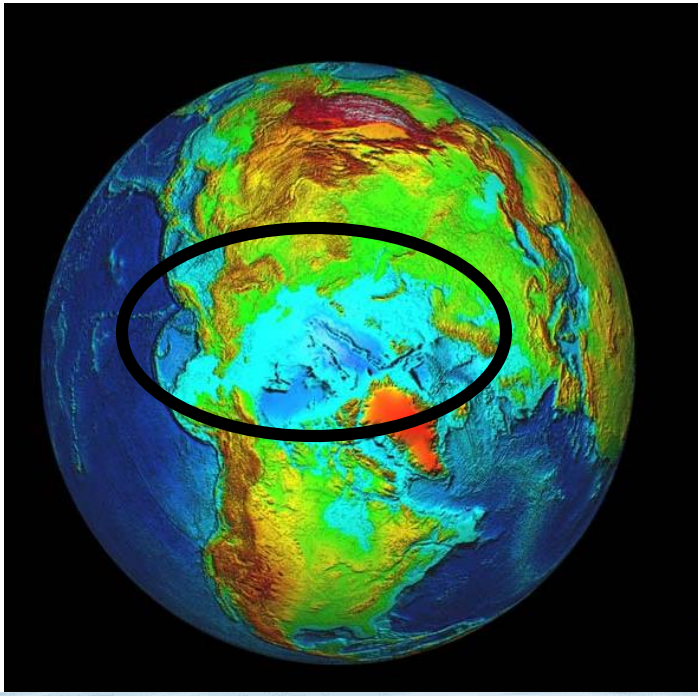


Reduction of Arctic sea ice may encourage shipping from Asia to Europe through the Arctic.

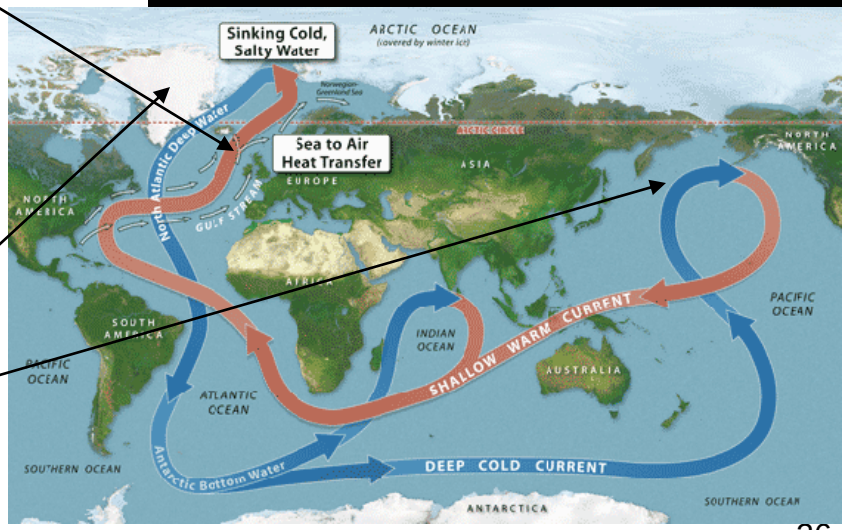
Arctic Ocean Water contributes to the formation of Deep Water in the North Atlantic. A freshening or warming could shut off the Global Circulation



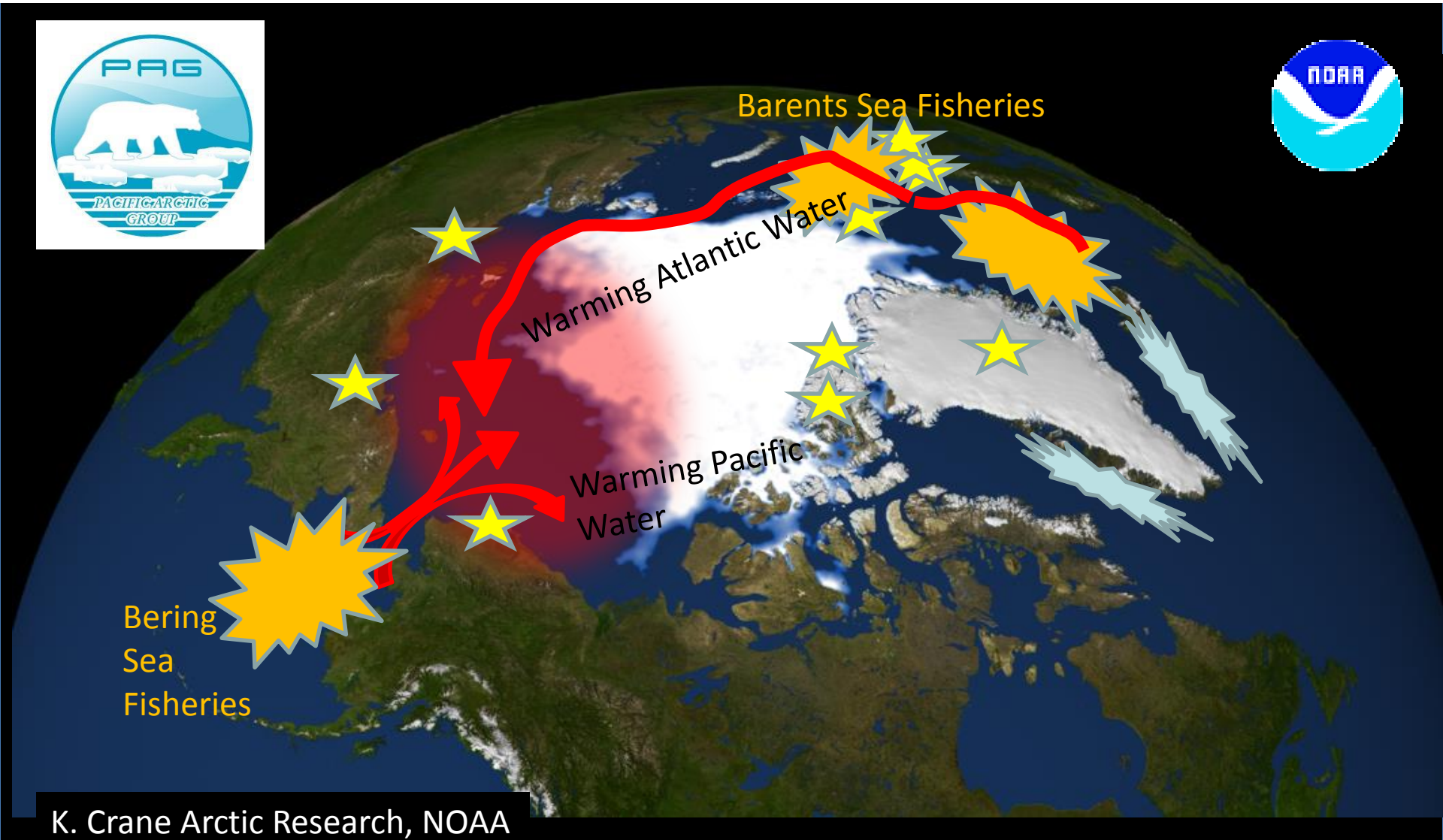
Possible Arctic Influences on Global Climate Change:



- Increase of methane and CO_2 in the atmosphere due to a thaw in the permafrost on land and under water
- Fresh water /salt water unbalances, Ocean circulation disruption
- Changing albedo of the planet due to melting of sea ice
- Extinction or migration of many species
- Rising sea level due to the melting of the Greenland Ice Cap.
- Increase in severe weather.



ARCTIC SYSTEM CHANGE DETECTION AND IMPACTS: A 5 Year Plan to Address Causes and Consequences of Sea Ice Loss, Warming Atmosphere, Warming Oceans and Changing Ecosystems

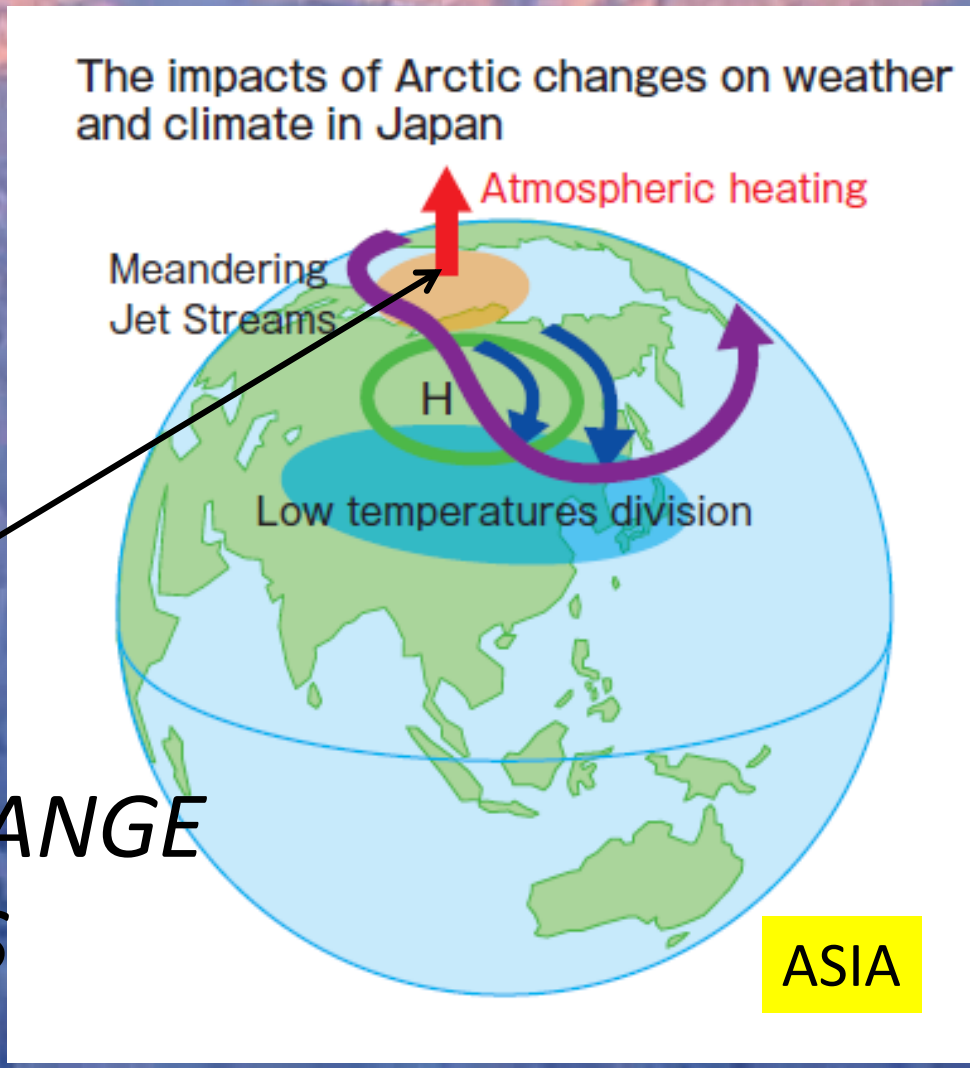


K. Crane Arctic Research, NOAA

Which parts of the Globe are responding to Arctic Change

NORTH AMERICA

NEED OBSERVATIONS FROM THE PACIFIC ARCTIC HOT SPOT



ASIA

IMPACTS OF ARCTIC CHANGE ON THE MID-LATITUDES

Arctic Observing Network (AON):

Toward a U.S. Contribution to Pan-Arctic Observing

- **Federal Arctic Observing Activities: Today**
  - **Atmosphere**
  - **Ocean and sea ice**
  - **Hydrology and cryosphere**
  - **Terrestrial ecosystems**
  - **Human dimensions**
  - **Paleoenvironment**
  - **Data and information management**

- **Federal Arctic Observing Activities: Tomorrow**
  - **Agencies' observing plans**
  - **A conceptual model for integration and coordination of existing and new observing activities**
  - **Data and information management**

- **International Cooperation**